

susceptible of exact measurement, but, as stated above, the readings of the wet bulb thermometer are considered the best measure available of the temperature actually felt by the human body.

It is very interesting to compare climatic conditions in Panama with conditions in various sections of the United States on this basis. Average daily maximum shade temperatures and the computed maximum daily sensible temperatures (wet bulb) for the month of July are presented in the following table:

Stations.	Actual average daily maximum temperature for July.	Computed average maximum sensible temperatures for July (wet bulb).
	° F.	° F.
Balboa Heights, C. Z.	87	79
Cristobal, C. Z.	84	78.5
Mobila.	90	77.7
New Orleans.	89	77
St. Louis.	87	73
Phoenix.	104	72
Kansas City.	86	72
New York.	82	70
Chicago.	80	69
El Paso.	94	68
Fresno.	100	66
Denver.	86	64
San Francisco.	64	57

It should be noted that maximum *shade* temperatures only are used in the above table. No attempt is made to estimate the superheating effects of the sun on bodies exposed to direct solar radiation.

It will be seen that the *average* daily maximum July temperatures are much higher in many sections of the United States than in Panama, but the maximum *sensible* temperatures are higher in Panama than anywhere in the United States, due to the prevailing high humidity. Midsummer conditions of temperatures and humidity in the Gulf States more closely approach the conditions that prevail in Panama.

Dry season sensible temperatures in Panama are about 3° F. lower than those of the rainy season, due to the lower humidity and higher wind movement that prevails in the dry season. This explains the less oppressive character of our dry-season weather.

The high sensible temperatures and hot, humid atmospheric conditions that prevail in Panama would seem to be productive of frequent cases of sunstroke and heat exhaustion, but such is *not* the case. Canal Zone vital statistics covering the past 13 years show but two deaths from sunstroke, one in Panama and one in Colon. The total number of cases of heat exhaustion reported among the entire population of about 120,000 during this 13-year period was only 21, and none of these cases proved fatal.

While deaths from overheating are extremely rare in Panama, it is undoubtedly true that the habitual lassitude and inefficiency of tropical labor is due in large measure to the prevailing conditions of temperature and humidity.

Sufficient data are not available upon which to base an exhaustive study of this subject, but it is thought that, in general, cases of sunstroke and heat exhaustion are relatively rare both in *extremely humid* hot climates and in *arid* hot climates. It is in the *moderately humid* warm climates, such as prevail in central and eastern sections of the United States, that cases of sunstroke and heat exhaustion are most prevalent. Such cases seem to occur more frequently in large cities, probably being aggravated by the excessive radiation of heat from street paving, sidewalks, and masonry walls, and also by the

lack of free air circulation in congested districts. Undernourishment and low vitality of the patients may be contributory causes.

Conditions of humidity powerfully affect plant life also. The blighting effects of the withering hot winds of Kansas that carry damage or destruction to growing crops are due more to *moisture deficit* than to *high temperatures*.

The needs of animal and plant life differ, and, generally speaking, the conditions of heat and humidity most favorable for luxuriant plant growth (warm and humid) are relatively unfavorable for human health and comfort.

The average maximum temperature records and the corresponding wet-bulb readings at stations in the United States used in the accompanying table were taken from a Weather Bureau report on "Relative Humidities and Vapor Pressures over the United States" by Mr. Preston C. Day, published as MONTHLY WEATHER REVIEW SUPPLEMENT No. 6. Wet-bulb temperatures corresponding to the daily maximum temperatures were computed from the daily maximum temperatures and the relative humidity.

COMFORTABLE TEMPERATURES.

By W. KÖPPEN.

[Abstracted from *Das Wetter*, July-August, 1918, pp. 116-117.]

The temperatures at which the greatest comfort is felt are those in the neighborhood of 18° C. Out of doors, temperatures are considered comfortable when they lie between 14 and 18° C. at night, and between 18 and 22° in the daytime. A person who would live the year around in such temperatures, however, would have to travel so much if he remains at sea-level, that he would have little time in a given locality to establish a home.

In the northern hemisphere in the vicinity of Europe, he would gradually move north from Cairo in January, February, and March; in April he would be in Seville; in May he would go northward to Greece or Italy; in July to London, Christiania, and Helsingfors; and through the second half of the year he would retrace his journey. In the East, he would find himself in January in Calcutta, in March in Hongkong, in May in Peking and Tokyo, and thence up the coast.

Such traveling as this, however, is not practical and the person who would seek to maintain a comfortable temperature throughout the year must do it by means of ascending and descending the mountains of his vicinity.—*C. L. M.*

OPTIMUM TEMPERATURE FOR HUMAN ENERGY.

By ELLSWORTH HUNTINGTON.

[Abstract translated from *La Nature Supplement*, Mar. 22, 1919.]

Prof. Ellsworth Huntington has published in the *Proceedings of the National Academy of Sciences* a study of this subject based on statistics.

1. If the temperature of the seasons in which the death rate is lowest is noted, it is found, in the cities of the United States as well as in those of Europe and Asia, a minimum in the springtime and in the autumn, when the mean daily temperature is in the neighborhood of 18° C.

2. If the maximum of work obtained from laborers in various factories extending from Connecticut to Florida is investigated, it is found that this maximum is obtained where the temperature oscillates about 17° C.

3. Finally, if, with a dynamometer, the muscular force of workers is measured during several seasons, it is found that the maximum efficiency occurs with a temperature of 16 to 19° C.